

Discuss factors affecting solubility

1) A solution contains a mixture of the two metal ions Cu^{2+} and Zn^{2+} , both of the same concentration. The solution is saturated with hydrogen sulfide and adding hydrochloric acid lowers the pH of the solution.

$$K_s(\text{CuS}) = 6.30 \times 10^{-36}$$

$$K_s(\text{ZnS}) = 1.6 \times 10^{-24}$$

Account for the fact that at a pH close to 7 all the metal sulfides will precipitate whereas only the most insoluble sulfides precipitate out at a lower pH.

In your answer, you should use equilibrium principles and both Cu^{2+} and Zn^{2+} as examples. (*No calculations are required.*)

2) Discuss the effect of decreasing the pH of the water on the solubility of $\text{Fe}(\text{OH})_3$.

3) A saturated solution of zinc hydroxide, $\text{Zn}(\text{OH})_2$, contains a small amount of solid $\text{Zn}(\text{OH})_2$ at the bottom of the container. The pH of the solution is increased. Discuss the effect of increasing the pH on the amount of solid present, and also on the nature and concentration of the species present in the solution. *No calculations are necessary.*

4) Discuss how the solubility of Ag_2CrO_4 will change if it is dissolved in the following solutions. *No calculations are necessary.*

i) $0.1 \text{ mol L}^{-1} \text{ K}_2\text{CrO}_4$

ii) $0.1 \text{ mol L}^{-1} \text{ NH}_3$

5) Discuss reasons for the fact that a precipitate of silver chloride dissolves on the addition of excess aqueous ammonia.

6) The K_s of aluminium hydroxide, $\text{Al}(\text{OH})_3$, at 25°C , is 3×10^{-34} , indicating that it has very low solubility. The solubility may be altered by changes in pH (due to acidic or basic properties) and formation of complex ions such as the aluminate ion, $[\text{Al}(\text{OH})_4]^-$.

Discuss why aluminium hydroxide becomes more soluble in aqueous solutions that have a pH less than 4, or a pH greater than 10. In your answer include:

- the equation for the reaction that relates to $K_s(\text{Al}(\text{OH})_3)$
- equations for the reactions that relate to changes in the solubility of aluminium hydroxide at pH less than 4 or greater than 10
- a discussion of the equilibrium principles involved.

7) Evaporating the sea-water to dryness would produce a mixture of salts including NaCl. However, precipitation of NaCl occurs if concentrated hydrochloric acid is added to a saturated NaCl solution. Explain why this precipitation occurs.